Estonian Information Technology College

# Availability

## *Operating systems I800*

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*There has been used materials from Margus Ernits, Katrin Loodus when creating current slides.*



# Service availability

- *Availability* – part of security

$$availability = \frac{service\ operation\ time}{service\ operation\ time + service\ outage\ time}$$

$$diagnostic\ cost = service\ outage\ time * labor\ cost * \mathbf{team\ size}$$

Labor costs can be eliminated in the formula by applying high availability implementation - then the cost is 0 or close to it (depending on the extent to which succeeds to eliminate or minimize the cost of labor).

# Allowed downtime of service

| Availability % | per year | per month | per week | per day |
|---|---|---|---|---|
| **90% ("one nine")** | **36.5 d (~877 h)** | **72 h** | **16.8 h** | **2.4 h** |
| 95% | 18.25 d | 36 h | 8.4 h | 1.2 h |
| 97% | 10.96 d | 21.6 h | 5.04 h | 43.2 m |
| 98% | 7.30 d | 14.4 h | 3.36 h | 28.8 m |
| **99% ("two nines")** | **3.65 d (~87 h)** | **7.20 h** | **1.68 h** | **14.4 m** |
| 99.5% | 1.83 d | 3.60 h | 50.4 m | 7.2 m |
| 99.8% | 17.52 h | 86.23 m | 20.16 m | 2.88 m |
| **99.9% ("three nines")** | **8.76 h (~8 h)** | **43.8 m** | **10.1 m** | **1.44 m** |
| 99.95% | 4.38 h | 21.56 m | 5.04 m | 43.2 s |
| **99.99% ("four nines")** | **52.56 m (~52 m)** | **4.38 m** | **1.01 m** | **8.66 s** |
| 99.995% | 26.28 m | 2.16 m | 30.24 s | 4.32 s |
| **99.999% ("five nines")** | **5.26 m (~5 m)** | **25.9 s** | **6.05 s** | **864.3 ms** |
| **99.9999% ("six nines")** | **31.5 s** | **2.59 s** | **604.8 ms** | **86.4 ms** |
| **99.99999% ("seven nines")** | **3.15 s** | **262.97 ms** | **60.48 ms** | **8.64 ms** |
| **99.999999% ("eight nines")** | **315.569 ms** | **26.297 ms** | **6.048 ms** | **0.864 ms** |
| **99.9999999% ("nine nines")** | **31.5569 ms** | **2.6297 ms** | **0.6048 ms** | **0.0864 ms** |

*legend:*

*d – days*

*h – hours*

*s – seconds*

*ms – milliseconds*

# Service availability

- A service has
  - Main functionality
    - If it is disturbed, then the service is down
  - Working time
    - At this time, the service should be available in accordance with the agreed conditions
  - Allowed maintenance time during which the availability of the service can be less than in agreement
    - Allowed *downtime* ie outage time
  - Interruption of Service
    - Unexpected outages and planned outages
    - The interrupt the accumulation (cumulation)

# Service availability

- A service has
  - Recovery time MTTR *Mean Time To Recover* (during that time the service can be restored). These include also other times:
    - ASA, Average Speed to Answer (respond to query)
    - TSF, *Time Service Factor* (how many % of calls will be answered)
    - FCR, *First-Call Resolution* (% of calls, which can be resolved without calling back)
    - TAT *Turn-Around Time* (the time spent for specific recovery action)
  - Criticality class - determines the permitted maintenance and other disruptions times, and the restoration of order of service
- Often there is a knot, which is a cause of service outage (SPOF *single point of failure*) – especially here would be needed to implement clustering

# Service availability

- The price of a service depends on required availability
- The service availability should be monitored
  - Register service interruptions
  - Inform clients, users of failure and approximate time of the elimination and finally the complete removal
  - Observe whether the service architecture allows to ensure the required availability

# Communication channel

- to be agreed with customer
  - communication channel(s) – SMS, e-mail, phone etc
  - response time – how fast there will be reacted
    - e-mail – when an e-mail will be sent then how often the e-mail will be read
  - language – in which language(s) will be the communication
    - in case of international team might not understand everything in Estonian
  - Procedure for notification
    - if a failure occurs and people are aware of that then it is reasonable to inform customer using agreed manner (eg SMS report) about that and the failure will be removed e.g. during 2 hours - can help to prevent a communication channel(s) clog (eg, customer support phone constantly busy)
    - when a failure is removed then again announce customers about that and if service has still not been recovered – only then there should be contacted with customer service

# High availiability (HA)

- HA
  - Service architectural approach to increase the availability of
- Contains
  - Suitable architecture to meet requirements
  - Contains the redundancy
  - Contains to monitor critical services functionality
  - Includes opportunities for reducing or eliminating the SPOF (*single point of failure*)

# High availiability (HA)

- *High availability* will be ensured by the redundancy of software and hardware where with help of cluster. There are independent nodes where every node has a copy of running OS and apps. High availability will be ensured by determining node or service failure and reorganizing work to ensure balance of work load among remaining nodes without or not remarkably losing perfomance

# Increasing availability

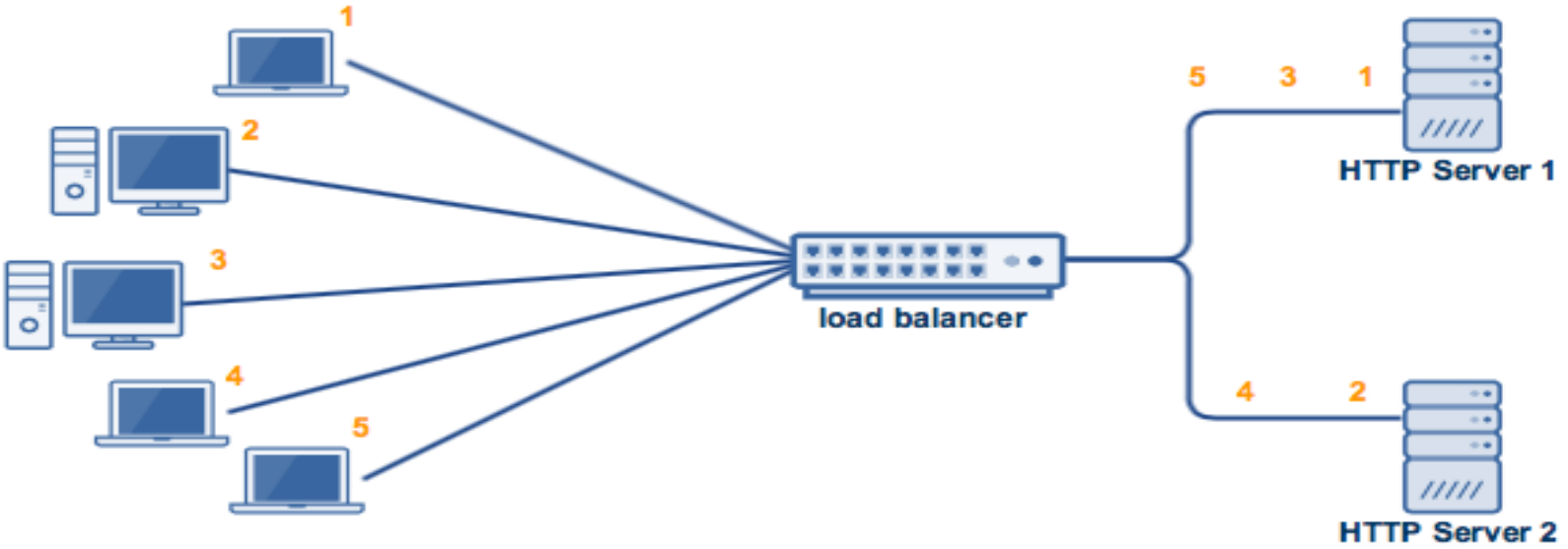
- *Clusters*
  - Computational clusters (not meant to increase the availability)
  - *FailOver (High Availability)* clusters – redundant clusters  (duplicated systems)
  - *Load Balancing* clusters – redundancy with load sharing

# *Failover Cluster*

- Service switch without administrator intervention
- Contains *active nodes* – currently at work
- Comprises a passive waiting nodes (*passive node*) – will be applied when active node does not work anymore
- Includes a *shared storage* between active and passive nodes
- Includes a functionality to lift service automatically from active to passive node (and back)
- Arbiter observes node availability and reorganizes services topology whenever needed
- EST https://wiki.itcollege.ee/index.php/Failover_Cluster
- ENG https://en.wikipedia.org/wiki/High-availability_cluster

# *Failover Cluster*

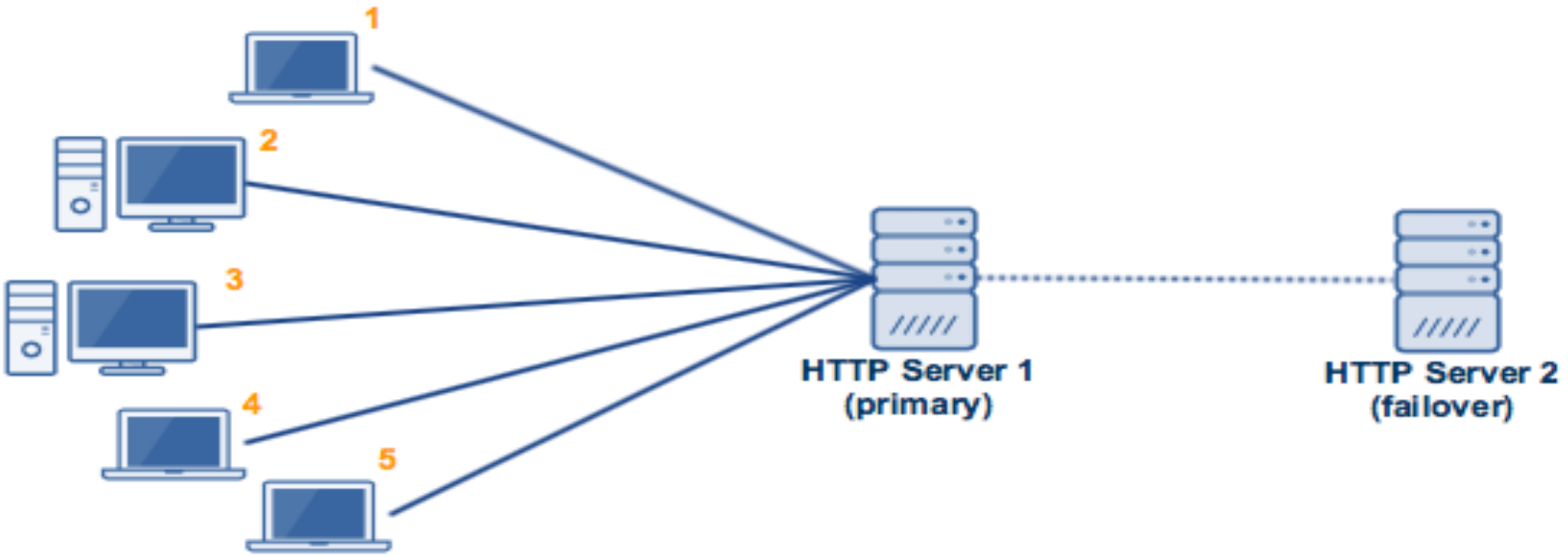
- *active-active*
  - configuration: two equal independent servers that share a load and both offer a service
  - *failover*: when one fails then the working one will take over until failed one fault will be fixed




http://cdn2.hubspot.net/hubfs/26878/images/active_active_high_availability_cluster_load_balancer.png

# *Failover Cluster*

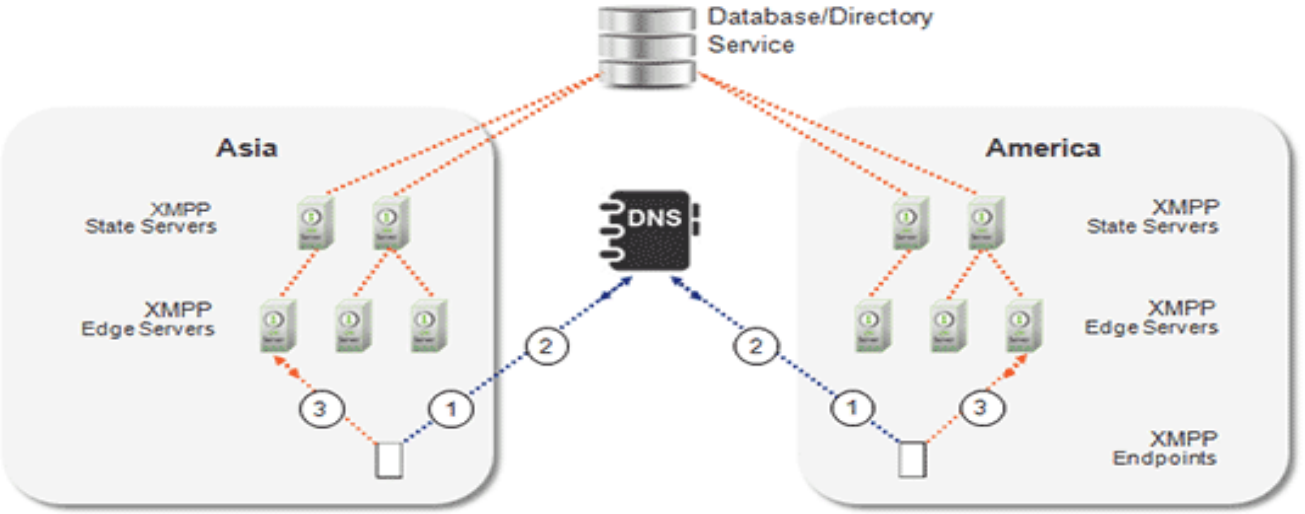
- *active-passive*
  - configuration: one main server and one backup server, only manin server offer the service
  - *failover*: when main server failure occurs then backup server will take over until main server fault will be fixed




http://cdn2.hubspot.net/hubfs/26878/images/active_passive_high_availability_cluster.png

# Geographic cluster

- Shared data can be SPOF (*Single Point of Failure*)
- Geographic cluster has different locations in both active and passive node, and the data are mirrored between different locations




http://www.eyeball.com/wp-content/uploads/2014/03/xmpp-lb.gif

# Backup

- Service data, software, and configuration backup is an important part of creating a new service
- When creating a new service, the backup plan must be created
  - Determines what needs to be backed up
  - Determines backuping frequency and type
  - Determines backup way and role
  - Speficies regular checking rules of backup
- Backing up a service usually means to backup:
  - data
  - programs
  - configuration

# Backup

- When it is clear what and how often to back up, you can select / configure the storage medium.
- Common data backup storage medium in enterprises is still a magnetic tape
  - Pros – cheap, supported and widespread
  - Cons – finding a specific file, and recovery can take much time. Replacing the tapes can be handmade (or expensive tape robot task)

http://www.backuphistory.com/

http://www.pcworld.com/article/2984597/storage/hard-core-data-preservation-the-best-media-and-methods-for-archiving-your-data.html

# Backup

- Second widespread backup storage is a hard disk
  - Simple to use. Cheap and large capacity.
  - It must be kept separate from the online information (in the second server, or a separate drive box)
- DVD and other optical storage media
  - Cheap
  - Writing speed per GB is slow
  - Risk of data writing failure is high
  - Small storage volume, changing is manual

# Backup plan

- Determines a file and directory list that needs to be backed up
- Determines a frequency and type of backup
  - *incremental* contain only that portion of data that has changed from previous incremental backup, restoring means full backup + all incremental backup media (can be many of them) https://en.wikipedia.org/wiki/Incremental_backup
  - *differential* saves data from last full backup, restoring means full backup + differential one (two backup media) https://en.wikipedia.org/wiki/Differential_backup
  - *full:* all data will be backed up and restoring means to restore same backup https://en.wikipedia.org/wiki/Backup
- Provides regular rules of the control for a backup
- Do not need include a backup method, and program description, as usually another administrator deals with it

# Disaster recovery

- *Disaster recovery guide/plan*
  - Lists the various recovery scenarios in case of emergencies
  - Must include instructions on how to restore service
  - It should be quickly accessible!
  - Disaster recovery will not be kept on the server (Services), to which it relates. If the server service is down (e.g. MS Sharepoint), you cannot access the recovery plans ...
  - It should be updated when the service infrastructure upgrades
  - Rapid changes often tend to forget, and backup and recovery plan are too old

# Disaster recovery

- Disaster recovery plan describes the various crises scenarios and their corresponding recovery plan
  - e.g.
    - Web server X system disk failes
      - Inform the owner of the service about system outage
      - Replace the hard disk
      - Restore the last full system backup and differential copy
      - Check the operation of the system
      - Inform the owner of the service system functioning again
- Great recovery plan also includes the time required to restore

# Disaster recovery

- Recovery plans should be regularly tested
  - This may be done for a reduced copy of a real system
    - e.g. in virtual machine
- Recovery plan must be created before the system is released into active use
- Recovery plans must be changed if the system changes
- Recovery plan must be printed (in case a large part of the system is destroyed)

# Backup and restore

- Backup and restoration must be tested!
  - Can backed up data also be restored?
  - Does recovery plan contain substantial crises and responding to instructions?
- Backing up should be automatic.
  - Handcrafted running backup script is ineffective.
- Failure of backup must be announced to administrator immediately.

# Data backup

- Data backup can be carried out (please see comparison)
  - During service working time *(online backup)*
    - It is difficult to ensure the integrity of the data
    - Of a particular service (for example, the MS SQL) require the adaptation of backup software side
  - When the service is not working (*offline backup*)
    - The service will be stopped for backup time
    - *Backup Window* – the predetermined time when the perfect time to make a backup copy
  - Disk Management System sided disk copy (*Shadow Copy Services*, BCV, LVM etc) allows you to quickly save the current state of the disk blocks and subsequently the tape to write

# Backup software

- The backup software deals with the
  - Level of disk blocks
  - Level of file system
  - Service level (is aware of the nature of the service and ensures and verifies the integrity of the data)

EST https://wiki.itcollege.ee/index.php/Incremental_backup

EST https://wiki.itcollege.ee/index.php/Rsync

EST https://wiki.itcollege.ee/index.php/Vabavaralised_varundusvahendid

EST https://wiki.itcollege.ee/index.php/Shadow_Copy

ENG https://en.wikipedia.org/wiki/Backup_software

ENG https://en.wikipedia.org/wiki/List_of_backup_software

ENG https://en.wikipedia.org/wiki/Comparison_of_backup_software

ENG https://en.wikipedia.org/wiki/Comparison_of_online_backup_services

ENG https://en.wikipedia.org/wiki/Comparison_of_file_synchronization_software

ENG https://en.wikipedia.org/wiki/List_of_data_recovery_software

# Backup software

- Good backup software
  - Does not stop the service (at least not for longer than agreed)
  - Backs up the required information: data, applications, configurations
  - Checks the integrity of the backup afterwards
  - Will report about backup success or failure
  - Observable (can be viewed when the backup began and ended)

# References


- Linux High Availability http://www.linux-ha.org/
- EST http://kuutorvaja.eenet.ee/wiki/Linux-HA_Debianiga
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- EST https://wiki.itcollege.ee/index.php/Failover_Cluster
- EST https://wiki.itcollege.ee/index.php/Windows_HPC_Server
- http://sbinfocanada.about.com/cs/management/a/databackup.htm


## Ubuntu Clustering


- https://wiki.ubuntu.com/UbuntuClusters
- https://help.ubuntu.com/community/Clustering
- https://wiki.ubuntu.com/EasyUbuntuClustering
- https://help.ubuntu.com/community/MpichCluster
- http://www.ubuntu.com/cloud
- https://apps.ubuntu.com/cat/applications/clusterssh/

# Questions?

# Thank you for your attention!